

## Claims

- [c1] 1. A proppant comprising a particulate substrate coated with an alpha-hydroxycarboxylic acid which has been polymerized.
- [c2] 2. The proppant of claim 1 wherein the alpha-hydroxycarboxylic acid is selected from glycolic, malic, lactic, gluconic, citric, mandelic, saccharic, mucic, and tartaric acid and mixtures thereof.
- [c3] 3. The proppant of claim 1 wherein the alpha-hydroxycarboxylic acid is glycolic.
- [c4] 4. The proppant of claim 1 wherein the particulate substrate is selected from natural and synthetic silica sand, glass beads, quartz, ceramics, thermoplastic resin, sintered bauxite, and metal oxides.
- [c5] 5. The proppant of claim 1 wherein the particulate substrate is silica sand and the alpha-hydroxycarboxylic acid is glycolic.
- [c6] 6. The proppant of claim 1 wherein the polymerized alpha-hydroxycarboxylic acid content is about 5% to about 20% by weight per dry weight of the particulate substrate.
- [c7] 7. The proppant of claim 1 wherein the polymerized alpha-hydroxycarboxylic acid content is about 8% to about 10% by weight per dry weight of the particulate substrate.
- [c8] 8. A method of making a proppant coated with an alpha-hydroxycarboxylic acid polymer comprising: heating a solution of monomeric alpha-hydroxycarboxylic acid with sized particulate substrate until polymerization of alpha-hydroxycarboxylic acid is completed.
- [c9] 9. The method of claim 8 wherein the monomeric alpha-hydroxycarboxylic acid is selected from glycolic, malic, lactic, gluconic, citric, mandelic, saccharic, mucic, and tartaric acid and mixtures thereof.
- [c10] 10. The method of claim 8 wherein the monomeric alpha-hydroxycarboxylic acid is glycolic acid.

- [c11] 11. The method of claim 8 wherein the particulate substrate is selected from natural and synthetic silica sand, glass beads, quartz, ceramics, thermoplastic resin, sintered bauxite, and metal oxides.
- [c12] 12. The method of claim 8 wherein the completion of polymerization is indicated by a change in the color of the polymerized alpha-hydroxycarboxylic acid/particulate substrate mixture.
- [c13] 13. The method of claim 8 wherein the polymerization is carried out until there is a reduction of moisture content of the said mixture to 5% or less.
- [c14] 14. The method of claim 8 wherein the polymerization is repeated to form multiple layers of polymerized alpha-hydroxycarboxylic acid on the particulate substrate material.
- [c15] 15. The method of claim 8 wherein the polymerization is carried out at a temperature above about 210 ° F.
- [c16] 16. The process of using proppants coated with polymerized alpha-hydroxycarboxylic acid for a gravel pack operation to fill the annular space between the formation and production screen and filter cake removal comprising:  
combining said proppants with a gravel pack fluid to create a mixture;  
pumping said mixture downhole into the annular space between the formation and production screen; and,  
letting said proppants contact the filter cake until the acid-soluble and acid-breakable components in the filter cake are broken down.
- [c17] 17. The process of claim 16 wherein the proppants are polyglycolic-acid coated sand.
- [c18] 18. The process of claim 16 wherein the gravel pack fluid comprises water, brines, and electrolytes.
- [c19] 19. The process of claim 16 wherein the gravel pack fluid comprises NaCl, KCl,  $\text{CaCl}_2$ ,  $\text{CaBr}_2$  and mixtures thereof.

- [c20] 20. The process of claim 16, wherein the mixture is left in the well for at least 24 hours.
- [c21] 21. The process of claim 16 wherein the proppants coated with polymerized alpha-hydroxycarboxylic acid are mixed with un-coated proppants.
- [c22] 22. The process of claim 21 wherein the proppants are polyglycolic-acid coated sand, and the un-coated proppants are conventional gravel pack sand.
- [c23] 23. A fluid useful for gravel packing a well comprising proppants coated with polymerized alpha-hydroxycarboxylic acid, water, and NaCl, KCl,  $\text{CaCl}_2$ ,  $\text{CaBr}_2$  and mixtures thereof.
- [c24] 24. The fluid of claim 23 wherein the proppants are coated with polyglycolic acid.
- [c25] 25. The process of using proppants coated with polymerized alpha-hydroxycarboxylic acid for a gravel pack operation to fill the annular space between the formation and production screen comprising:  
combining said proppants with a gravel pack fluid to create a mixture, and  
pumping said mixture downhole into the annular space between the formation and production screen.
- [c26] 26. The process of claim 25 wherein the proppants are coated with polyglycolic acid.